Agilent
4287A RF LCR Meter
1 MHz - 3 GHz

Data Sheet



Specifications

Specifications describe the instrument's warranted performance over the temperature range of 5 °C to 40 °C (except as noted). Supplemental performance characteristics are intended to provide helpful information for using certain non-warranted performance parameters with the instrument. These are denoted as SPC (supplemental performance characteristics), typical, or nominal. Warmup time must be greater than or equal to 30 minutes after power on for all specifications.

Basic Measurement Characteristics

Measurement parameters

Impedance parameters	|Z|, |Y|, Ls, Lp, Cs, Cp, Rs, Rp, X, G, B, D, Q, θz [°], θz [rad], θy [°], θy [rad] (A maximum of four parameters can be displayed at one time.)

Measurement range

Measurement range	200 mΩ to 3 kΩ (Frequency = 1 MHz, Averaging factor = 8, Oscillator level ≥ –33 dBm, Measurement uncertainty ≤ ± 10 %, Calibration is performed within 23 °C ± 5 °C, Measurement is performed within ± 5 °C from the calibration temperature

Source characteristics

Frequency

Range	1 MHz to 3 GHz
Resolution	100 kHz
Uncertainty	± 10 ppm (23 °C ± 5 °C) ± 20 ppm (5 °C to 40 °C)

Basic Measurement Characteristics

Oscillator level

Range	
Cable length: 1m	
Power (when 50 Ω LOAD is connected to the test port)	–40 dBm to 1 dBm (Frequency ≦ 1 GHz) –40 dBm to 0 dBm (Frequency > 1 GHz*1)
Current (when SHORT is connected to the test port)	0.0894 mA_{rms} to 10 mA_{rms} (Frequency ≥ 1 GHz) 0.0894 mA_{rms} to 8.94 mA_{rms} (Frequency > 1 GHz*1)
Voltage (when OPEN is connected to the test port)	4.47 mV_{rms} to 502 mV_{rms} (Frequency ≥ 1 GHz) 4.47 mV_{rms} to 447 mV_{rms} (Frequency > 1 GHz*1)
Cable length: 2m	(when Option 4287A-020 is used)
Power	Subtract the following attenuation from the power (setting value) at 1 m cable length: Attenuation [dB] = $0.37 \times \sqrt{F}$ (F: Frequency [GHz])
Resolution	0.1 dB*2
Uncertainty	
Cable length: 1 m	
Power (when 50 Ω LOAD is connected to the test port)	
Frequency ≤ 1 GHz	± 2 dB (23 ± 5 °C) ± 4 dB (5 °C to 40 °C)
Frequency > 1 GHz	± 3 dB (23 ± 5 °C) ± 5 dB (5 °C to 40 °C)
Cable length: 2 m	(when Option 4287A-020 is used)
Power	Add 1 dB to the uncertainty at 1 m cable length.

Output Impedance

Output impedance	50 Ω (nominal)

*1. It is possible to set more than 0 dBm (447 mV, 8.94 mA) oscillator level at frequency > 1 GHz. However, the characteristics at this setting are not guaranteed.
*2. When the unit is set at mV or mA, the entered value is rounded to 0.1 dBm resolution.

Basic Measurement Characteristics

Measurement accuracy

Conditions of accuracy specifications

Temperature	23 ± 5 °C
Accuracy-specified plane	7-mm connector of 3.5-mm-7-mm adapter connected to 3.5-mm terminal of test heads

Measurement uncertainty

When OPEN/SHORT/LOAD calibration is performed:	
|Z|, |Y|	$\pm(E_a + E_b)$ [%]
q	$\pm\frac{(E_a + E_b)}{100}$ [rad]
L, C, X, B	$\pm(E_a + E_b) \times \sqrt{(1 + D_x^2)}$ [%]
R, G	$\pm(E_a + E_b) \times \sqrt{(1 + Q_x^2)}$ [%]
D	
at $\left\|D_x \tan\left(\frac{E_a + E_b}{100}\right)\right\| < 1$	$\pm\frac{(1 + D_x^2)\tan\left(\frac{E_a + E_b}{100}\right)}{1 \pm D_x \tan\left(\frac{E_a + E_b}{100}\right)}$
at $D_x \leq 0.1$	$\pm\frac{E_a + E_b}{100}$
Q	
at $\left\|Q_x \tan\left(\frac{E_a + E_b}{100}\right)\right\| < 1$	$\pm\frac{(1 + Q_x^2)\tan\left(\frac{E_a + E_b}{100}\right)}{1 \pm Q_x \tan\left(\frac{E_a + E_b}{100}\right)}$
at $\frac{10}{E_a + E_b} \geq Q_x \geq 10$	$\pm Q_x^2 \frac{E_a + E_b}{100}$

When OPEN/SHORT/LOAD/LOW-LOSS C calibration is performed (SPC):	
|Z|, |Y|	$\pm(E_a + E_b)$ [%]

Basic Measurement Characteristics

q	$\pm \frac{E_c}{100}$ [rad]
L, C, X, B	$\pm\sqrt{(E_a + E_b)^2 + (E_c D_x)^2}$ [%]
R, G	$\pm\sqrt{(E_a + E_b)^2 + (E_c Q_x)^2}$ [%]
D	
$\left\lvert D_x \tan\left(\frac{E_c}{100}\right)\right\rvert < 1$	$\pm\frac{(1 + D_x^2)\tan\left(\frac{E_c}{100}\right)}{1 \pm D_x \tan\left(\frac{E_c}{100}\right)}$
$D_x \leq 0.1$	$\pm \frac{E_c}{100}$
Q	
$\left\lvert Q_x \tan\left(\frac{E_c}{100}\right)\right\rvert < 1$	$\pm\frac{(1 + Q_x^2)\tan\left(\frac{E_c}{100}\right)}{1 \pm Q_x \tan\left(\frac{E_c}{100}\right)}$
$\frac{10}{E_c} \geq Q_x \geq 10$	$\pm Q_x^2 \frac{E_c}{100}$

Definition of each parameter

D_x =	Measurement value of D
Q_x =	Measurement value of Q
E_a =	(Within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)
Oscillator level ≥ –33 dBm	
Frequency ≥ 1 MHz, ≤ 100 MHz	± 0.65 [%]
Frequency > 100 MHz, ≤ 500 MHz	± 0.8 [%]
Frequency > 500 MHz, ≤ 1 GHz	± 1.2 [%]
Frequency > 1 GHz, ≤ 1.8 GHz	± 2.5 [%]

Basic Measurement Characteristics

Frequency > 1.8 GHz, ≤ 3 GHz	± 5 [%]
Oscillator level < –33 dBm	
Frequency ≥ 1 MHz, ≤ 100 MHz	± 1 [%]
Frequency > 100 MHz, ≤ 500 MHz	± 1.2 [%]
Frequency > 500 MHz, ≤ 1 GHz	± 1.2 [%]
Frequency > 1 GHz, ≤ 1.8 GHz	± 2.5 [%]
Frequency > 1.8 GHz, ≤ 3 GHz	± 5 [%]
E_b =	$\pm\left(\frac{Z_s}{\lvert Z_x\rvert} + Y_o \bullet \lvert Z_x\rvert\right) \times 100$ [%] ($\lvert Z_x\rvert$: Measurement value of $\lvert Z\rvert$)
E_c =	$\pm\left(0.06 + \frac{0.08 \times F}{1000}\right)$ [%] (F: Frequency [MHz])
Z_s =	(Within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)
Oscillator level ≥ –33 dBm, Averaging factor ≥ 8	± (20 + 0.5 × F) [m Ω] (F: Frequency [MHz])
Oscillator level ≥ –33 dBm, Averaging factor < 7	± (50 + 0.5 × F) [m Ω] (F: Frequency [MHz])
Oscillator level ≥ –33 dBm,	± (100 + 0.5 × F) [m Ω] (F: Frequency [MHz])
Y_o =	(Within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)
Oscillator level ≥ –33 dBm, Averaging factor ≥ 8	± (30 + 0.15 × F) [µS] (F: Frequency [MHz])
Oscillator level ≥ –33 dBm, Averaging factor < 7	± (50 + 0.15 × F) [µS] (F: Frequency [MHz])
Oscillator level ≥ –33 dBm,	± (100 + 0.15 × F) [µS] (F: Frequency [MHz])

Basic Measurement Characteristics

NOTE: At the following points, measurement error may exceed the specifications described here due to the 4287A's spurious characteristics:

109.7 MHz, 153.6 MHz, 177.2 MHz, 256.0 MHz, 329.1 MHz, 460.8 MHz, 768.0 MHz

Examples of calculated impedance measurement accuracy

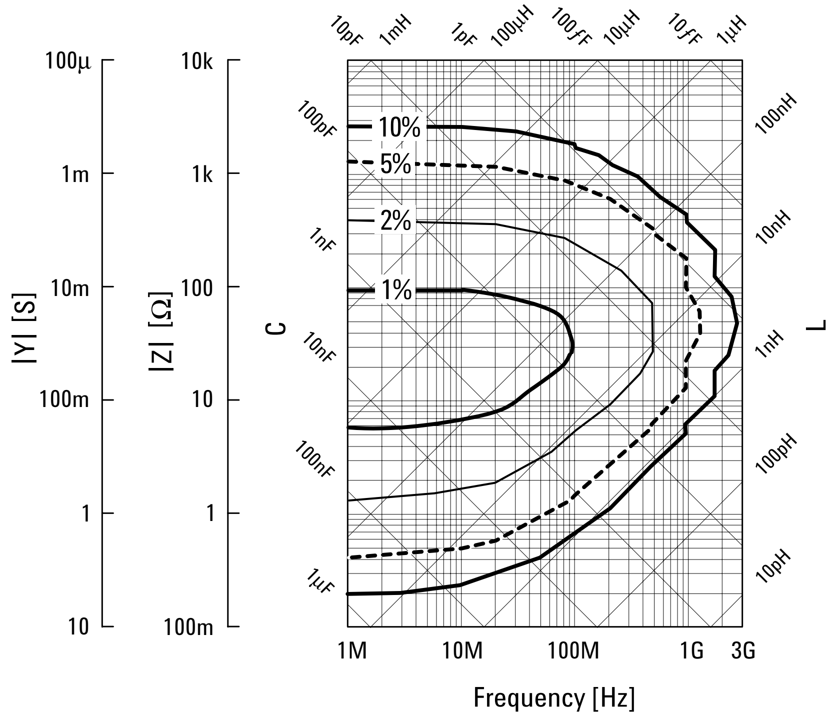


Figure 1. Oscillator level ≥ –33 dBm, averaging factor ≥ 8, temperature deviation ≤ 5 °C

Basic Measurement Characteristics

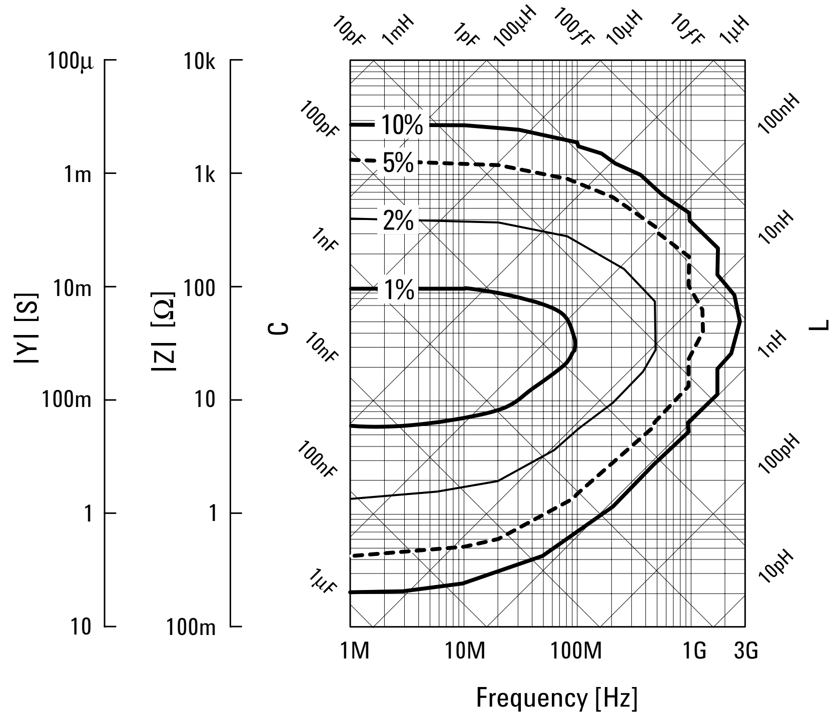


Figure 2. Oscillator level ≥ –33 dBm, averaging factor ≤ 7, temperature deviation ≤ 5 °C

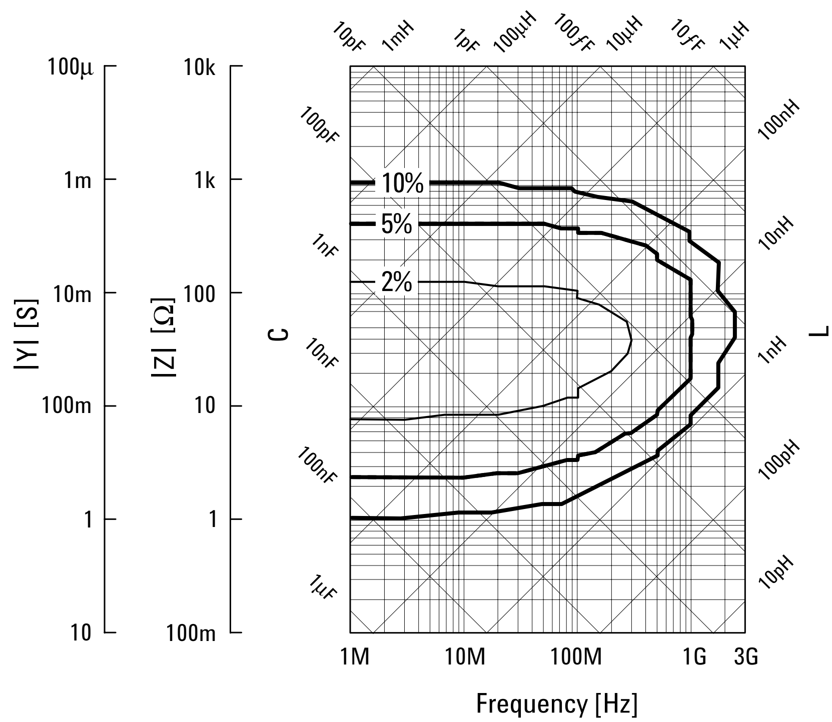


Figure 3. Oscillator level < –33 dBm, temperature deviation ≤ 5 °C

Basic Measurement Characteristics

Timing chart and measurement time (Typical)

Timing chart of handler interface signal (Typical)

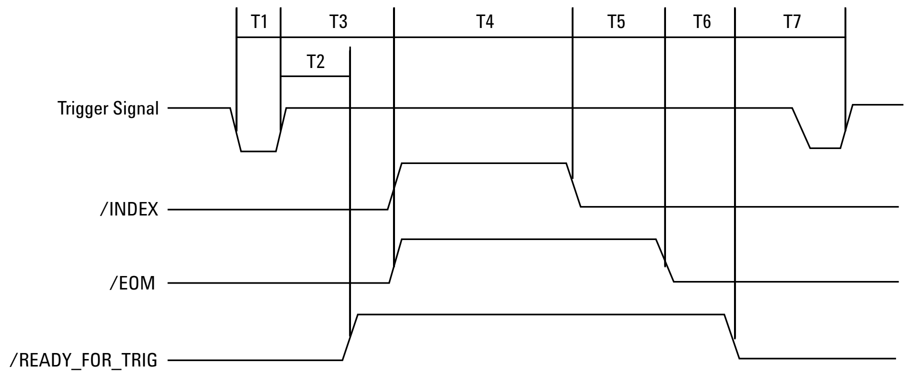


Figure 4. Timing chart of handler interface

Table 1. Value T1 through T7 (Typical)

		Test Condition				Timing		
		Screen setting	**Display**	**R_{dc} meas.**	**Comparator**	**Min.**	**Median**	**Max.**
T1	Trigger pulse width	-	-	-	-	2μs	-	-
T2	Trigger response time of Ready_for_Trig	-	-	-	-	-	0.3 ms	0.5 ms
T3	Trigger response time of INDEX and EOM	-	-	-	-	-	0.4 ms	0.6 ms
T4	Measurement time (*1)	-	-	Off	-	-	5.7 ms	5.9 ms
		-	-	On	-	-	7.5 ms	7.7 ms
T5	Measurement data calculation time	-	-	-	Off	-	0.3 ms	0.4 ms
		-	-	-	On	-	0.4 ms	0.4 ms
T6	Ready_for_Trig setting time	1 point meas. Ls-Q meas.	Off	-	-	-	0.1 ms	0.3 ms
		1 point meas. Ls-Q meas.	On	On	On	-	9.8 ms	10.2 ms
		List meas. 3 points meas. Ls-Q meas.	On	On	On	-	9.8 ms	10.2 ms
T7	Trigger wait time	-	-	-	-	0	-	-

*1: 1 point measurement, Trigger delay=0, Point delay=0

Basic Measurement Characteristics

Details of measurement time (T4)

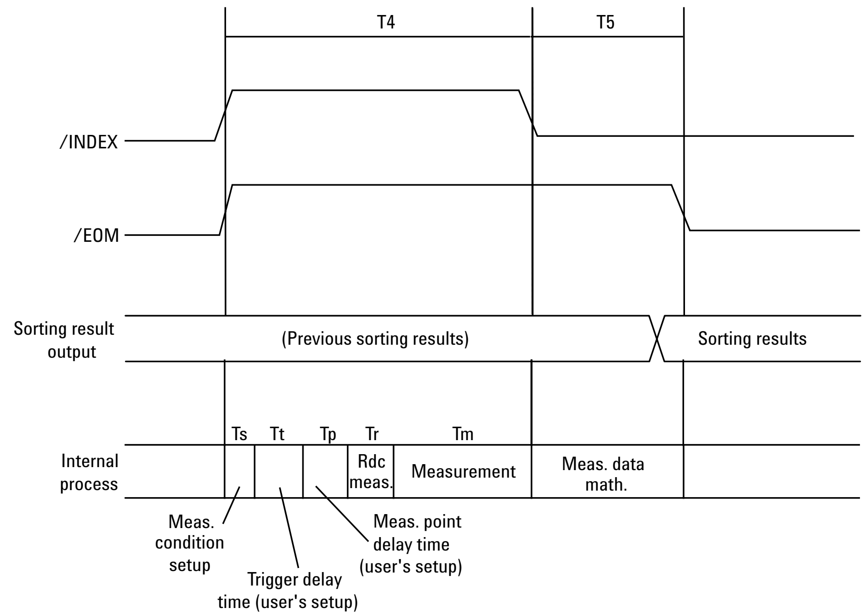


Figure 5. Measurement time T4 at single point measurement

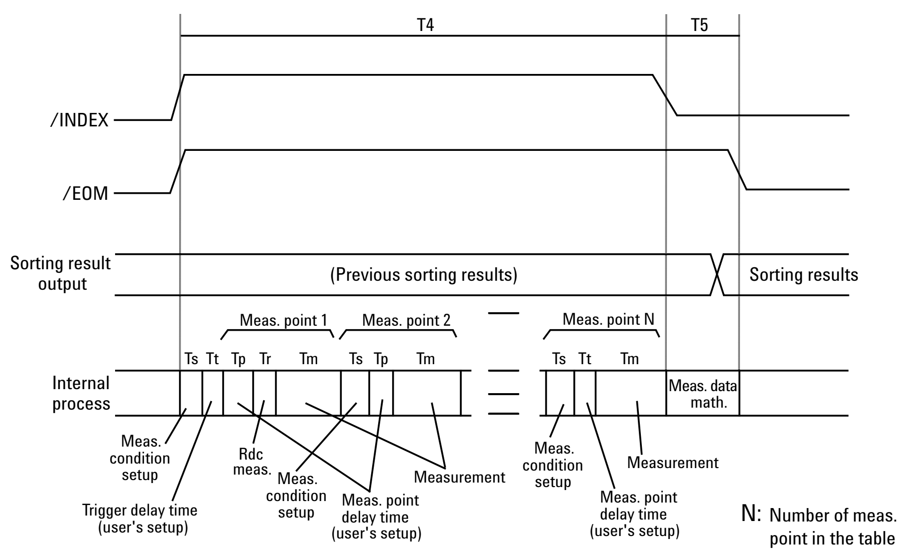


Figure 6. Measurement time T4 at list measurement

Measurement Support Functions

Error correction function

Available calibration and compensation

OPEN/SHORT/LOAD Calibration	Connect OPEN, SHORT, and LOAD standards to the desired reference plane and measure each kind of calibration data. The reference plane is called calibration reference plane.
Low-Loss Capacitor Calibration	Connect the dedicated standard (Low-Loss Capacitor) to the calibration reference plane and measure the calibration data.
Port Extension Compensation (Fixture Selection)	When a device is connected to the terminal that is extended from the calibration reference plane, set the electrical length between the calibration plane and the device contact. Select a model number of the registered test fixtures in the 4287A's softkey menu or enter the electrical length for user's test fixture.
OPEN/SHORT Compensation	When a device is connected to the terminal that is extended from the calibration reference plane, make OPEN and SHORT states at the device contact and measure each kind of compensation date.

Calibration/compensation data measurement point

Data Measurement Points	Same as measurement points which is set in the measurement point setup display. (Changing the frequency or oscillator level settings after the calibration or compensation makes the calibration and compensation data invalid.)

Measurement Support Functions

DC resistance (Rdc) measurement

Measurement range	0.1 Ω to 100 Ω
Measurement resolution	1 mΩ
Test signal level	1 mA (maximum)
Error correction	OPEN/SHOR T/LO AD Calibration, OPEN/SHORT Compensation. (Changing the frequency or oscillator level settings after the calibration or compensation makes the calibration and compensation data invalid.)
Measurement uncertainty	$\pm\left[1 + \left(\frac{0.05}{R_{dut}} + \frac{R_{dut}}{10000}\right) \times 100\right]$ [%] R_{dut}: DC resistance measurement v alue [Ω] (Within ± 5 °C from the calibration temperature. Measurement accuracy applies when the calibration is performed at 23 °C ± 5 °C. When the calibration is performed beyond 23 °C ± 5 °C, the measurement accuracy decreases to half that described.)

Trigger function

Trigger mode	Internal, External (external trigger input connector or handler interface), Bus (GPIB or LAN), Manual (front key)

Averaging function

Setting range	1 to 100 (integer)

Measurement Support Functions

Display

Type/Size	Color LCD, 8.4 inch
Resolution	640 dots $\times$ 480 lines

List measurement function

Number of measurement points	32 points for each table (maximum)
Number of tables	8 tables

Test signal level monitor function

Uncertainty of monitor value	$\pm\left[30 + \left(10^{\frac{A}{20}} - 1\right) \times 100 + B\right]$ [%](SPC) A: Uncertainty of oscillator level [dB] B: Uncertainty of impedance measurement [%]

Mass storage

Built-in flexible disk drive	3.5 inch, 720 KByte or 1.44 KByte, DOS format
Built-in hard disc drive	About 18 GByte

Measurement Support Functions

Interface

GPIB

Standard conformity	IEEE 488.1-1987,IEEE 488.2-1987
Available functions (function code)	SH1,AH1,T6,TE0,L4,LE0,SR1,RL0,PP0, DT1,DC1,C0,E2
Numerical data transfer format	ASCII
Protocol	IEEE 488.2-1987

Handler interface

Connector type	36 pin D-SUB connector
Signal type	Negative logic, opto-isolated, open collector output
Output signal	• BIN sort result (BIN 1 to BIN 13, OUT_OF_GOOD_BINS) • DC resistance pass/fail (DCR_OUT_OF_RANGE) • Overload (OVLD) • Alarm (ALARM) • End of analog measurement (INDEX) • End of measurement (EOM) • Ready for trigger (READY_FOR_TRIG)
Input signal	• External trigger (EXT_TRIG) • K ey lock (KEY_LOCK)
Pin location	See the follo wing figure. Refer to Programming Manual for the definition of each pin.

LAN interface

Standard conformity	10 Base-T or 100 Base-TX (automatically switched), Ethertwist, RJ45 connector
Protocol	TCP/IP
Functions	Telnet, FTP

Measurement Support Functions

Measurement terminal (at test head)

Connector type	3.5-mm (female) connector (can be converted to 7-mm connector using the 3.5 mm-7 mm adapter)

Rear panel connectors

External reference signal input connector

Frequency	10 MHz ± 10 ppm (SPC)
Level	≥ 0 dBm (SPC)
Input impedance	50 Ω (nominal)
Connector type	BNC (female)

Internal reference signal output connector

Frequency	10 MHz (nominal)
Uncertainty of frequency	Same as frequency uncertainty described in "Source Characteristics" on page 3
Level	+2 dBm (nominal)
Output impedance	50 Ω (nominal)
Connector type	BNC (female)

External trigger input connector

Level	LOW threshold voltage: 0.5 V HIGH threshold voltage: 2.1 V Input level range: 0 to +5 V
Pulse width (Tp)	≥ 2 µsec (SPC) See Figure 8 for definition of Tp
Polarity	Positive or Negative (selective)
Connector type	BNC (female)

Measurement Support Functions

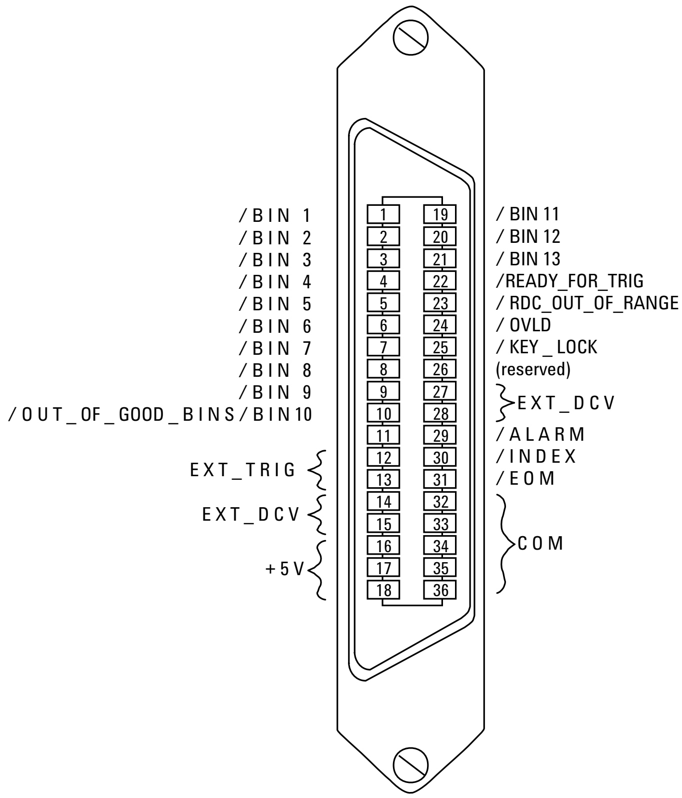


Figure 7. Pin location of handler interface

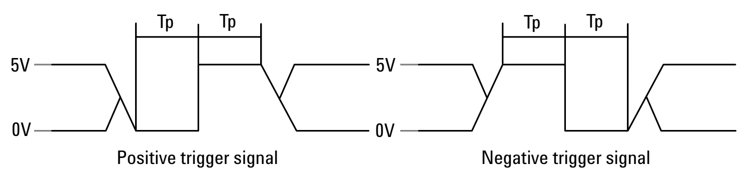


Figure 8. Definition of pulse width (Tp)

General Characteristics

Environment conditions

Operating condition

Temperature	5 °C to 40 °C
Humidity (at wet bulb temperature ≤ 29 °C, without condensation)	
Flexible disk drive non-operating condition	20% to 80% RH
Flexible disk drive operating condition	15% to 90% RH
Altitude	0 to 2,000 m (0 to 6,561 feet)
Vibration	0.5 G maximum, 5 Hz to 500 Hz
Warmup time	30 minutes

Non-operating storage condition

Temperature	– 20 °C to + 60 °C
Humidity (at wet bulb temperature ≤ 45 °C, without condensation)	15% to 90% RH
Altitude	0 to 4,572 m (0 to 15,000 feet)
Vibration	1 G maximum, 5 Hz to 500 Hz

General Characteristics

Other specifications

EMC CE ISM 1-A N10149	European Council Directive 89/336/EEC IEC 61326-1:1997+A1 CISPR 11:1990 / EN 55011:1991 Group 1, Class A IEC 61000-4-2:1995 / EN 61000-4-2:1995 4 kV CD / 8 kV AD IEC 61000-4-3:1995 / EN 61000-4-3:1996 3 V/m, 27-1000 MHz, 80% AM IEC 61000-4-4:1995 / EN 61000-4-4:1995 1 kV power / 0.5 kV Signal IEC 61000-4-5:1995 / EN 61000-4-5:1995 0.5 kV Normal / 1 kV Common IEC 61000-4-6:1996 / EN 61000-4-6:1996 3 V, 0.15-80 MHz, 80% AM IEC 61000-4-11:1994 / EN 61000-4-11:1994 100% 1cycle NOTE-1: When tested at 3 V/m according to EN 61000-4-3:1996, the measurement accuracy will be within specifications over the full immunity test frequency range of 27 to 1000 MHz except when the analyzer frequency is identical to the transmitted interference signal test frequency. NOTE-2: When tested at 3 V according to EN 61000-4-6:1996, the measurement accuracy will be within specifications over the full immunity test frequency range of 0.15 to 80 MHz except when the analyzer frequency is identical to the transmitted interference signal test frequency. AS/NZS 2064.1/2 Group 1, Class A
Safety CE ISM 1-A LR95111C	European Council Directive 73/23/EEC IEC 61010-1:1990+A1+A2 / EN 61010-1:1993+A2 INSTALLATION CATEGORY II, POLLUTION DEGREE 2 INDOOR USE IEC60825-1:1994 CLASS 1 LED PRODUCT CAN/CSA C22.2 No. 1010.1-92
Power requirement	90 V to 132 V, or 198 V to 264 V (automatically switched), 47 Hz to 63 Hz, 350 VA max.
Weight	
Main unit	16 kg (SPC)
Test head	0.3 kg (SPC)
Dimensions	
Main unit	See Figure 9 through Figure 11
Test head	See Figure 12

General Characteristics

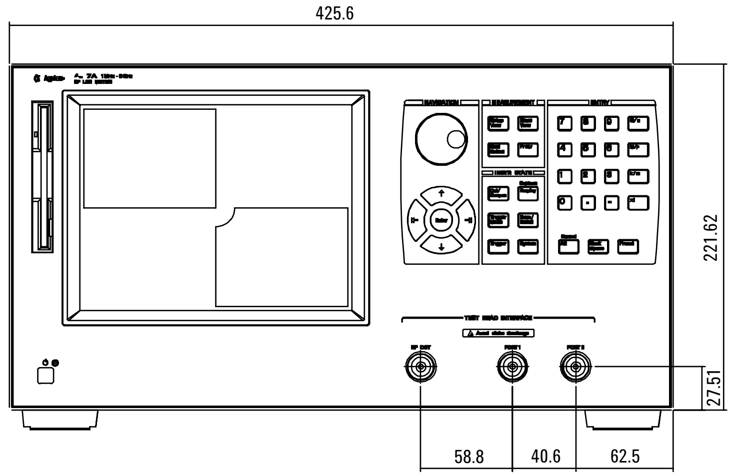


Figure 9. Main unit dimensions (front view, in millimeters, typical)

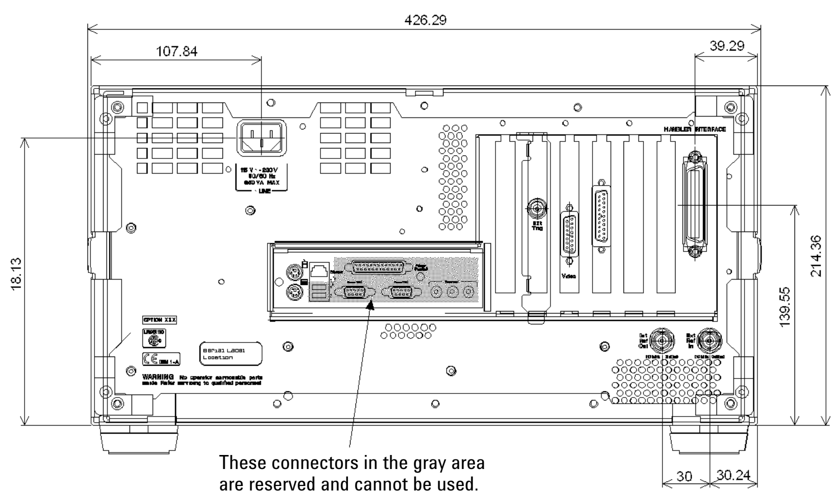


Figure 10. Main unit dimensions (rear view, in millimeters, typical)

General Characteristics

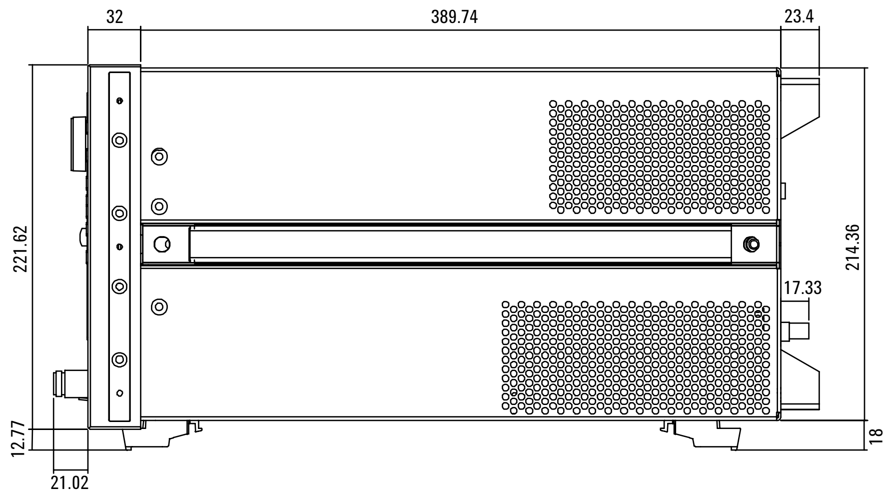


Figure 11. Main unit dimensions (side view, in millimeters, typical)

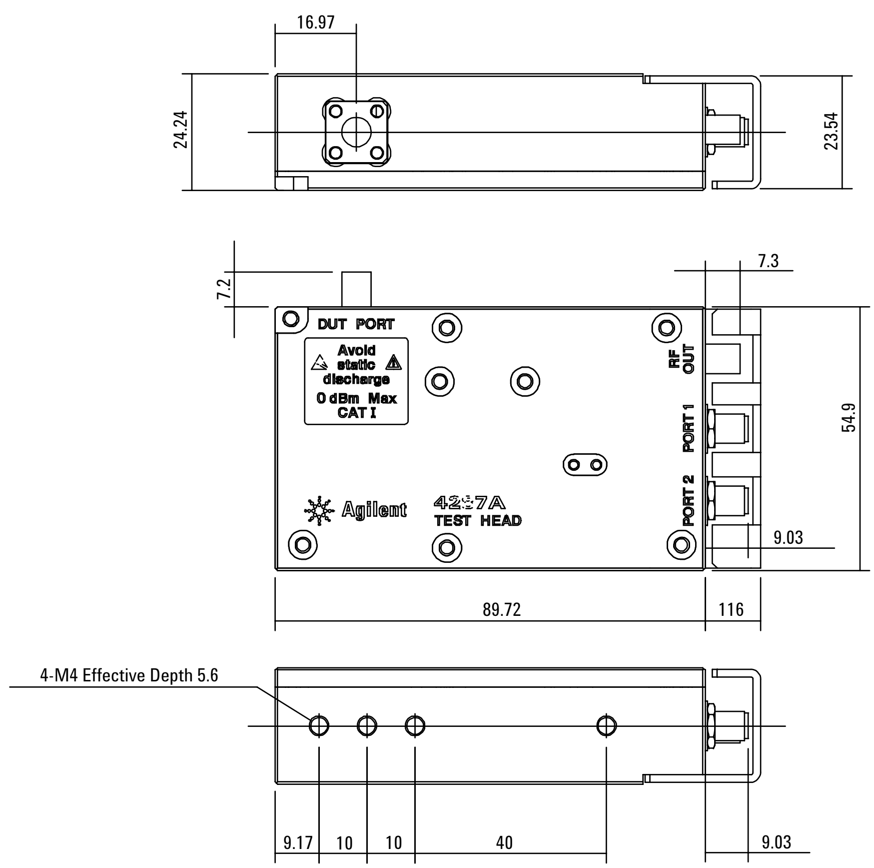


Figure 12. Test head dimensions (in millimeters, typical)

General Characteristics

Furnished accessories

Order model/option number	Description	Qty
Agilent 4287A	Agilent 4287A RF LCR meter (main unit)	1
	Test head (with 1 m cable)	1
	N (m)-SMA (f) adapter	3
	Wrench (for 3.5 mm/SMA connector)	1
	CD-ROM (Operation manual, Programming manual and Sample Program)	1

Options

4287A-004	Add working standard set	1
4287A-020	Add test fixture extension cable set	1
4287A-700	16195B calibration kit	1
4287A-710	Test fixture stand	1
4287A-720	3.5 mm - 7 mm coaxial adapter	1
4287A-810	Add keyboard	1
4287A-820	Add mouse	1
4287A-1A7	ISO 17025 compliant calibration	1
4287A-ABJ	Japan-Japanese localization	1
4287A-ABA	U.S.-English localization	1
4287A-0BW	Add service manual	1
4287A-1CM	Rack flange kit	1
4287A-1CN	Front handle kit	1
4287A-1CP	Handle/rack mount kit	1

Option 4287A-004 Working Standard Set Characteristics

Furnished devices

Short device	1.0 × 0.5 mm (part number: 16191-29005) 1.6 × 0.8 mm (part number: 16191-29006) 2.0 × 1.25 mm (part number: 16196-29007) 3.2 × 1.6 mm (part number: 16196-29008)
Resistor	1.0 × 0.5 mm (part number: 5182-0433) 1.6 × 0.8 mm (part number: 5182-0434) 2.0 × 1.25 mm (part number: 5182-0435) 3.2 × 1.6 mm (part number: 5182-0436)

DC resistance

Resistor	51 Ω ± 0.5%

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Latin America:
(tel) (305) 269 7500

Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
Contacts revised: 9/17/04

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